SWRHL-54r

ANIMAL INVESTIGATION PROGRAM BASELINE STUDIES: SUPPLEMENTAL TEST SITE "C"

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National Center for Radiological Health

September 13, 1968

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ABSTRACT

The Animal Investigation Progam (AIP) collected tissue samples from two Mule deer and three beef cattle for radioanalysis and histopathologic studies prior to the Faultless event. Pathologic lesions present and detectable body burdens of selected radioisotopes were comparable to those found in routine sacrifices.

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INTRODUCTION

The Animal Investigation Program (AIP) developed an operational plan to support the activities proposed for the Supplemental Test Site (STS). This plan involved the collection of tissue samples from two mule deer and three beef cattle for radioanalysis and histopathologic studies prior to Project Faultless. Each event was to be followed by the collection of a like number of animals and tissue samples if there was a likelihood that an exposure to radioactive isotopes had occurred. Collection of animals and techniques of radioanalysis were to be the same as those employed in past studies.* Tissues submitted for histopathology included heart, kidneys, liver, lung, striated muscle, spleen, thyroid, and any other tissue appearing grossly abnormal. A thin section was taken of each organ and preserved in formalin prior to submission to Dr. Gordon Solomon at Colorado State University for microscopic examination.

Just prior to the Faultless Event approximately 5,000 sheep were grazing 10 to 25 miles from Ground Zero. A U. S. Public Health Service (USPHS) certified monitor and the AIP veterinarian were stationed with the sheepherders prior to and during the event to advise the sheepherders of the time of the event and document any damages that might occur from ground shock or venting. Since there was no venting and only moderate ground shock involved, no animals were collected following the Faultless Event.

*Southwestern Radiological Health Laboratory Intralaboratory Technical Report ITR-11.

PROCEDURES

Arrangements were made with Mr. Grube, owner of the K Ranches, to purchase three head of cattle grazing in the STS area prior to the scheduled event. These cattle were then transported to the Nevada Test Site (NTS), Well #3, USPHS facilities for sacrifice.

As an item of general interest, it should be pointed out that animals purchased for analysis are frequently culls that are of questionable value to the owner due to existing gross pathological processes.* Even though gross pathology is often present, market price is paid for these animals in order to maintain good public relations with the livestock producers in the area.

Additionally, permission was obtained from the Nevada Fish and Game commission to collect two mule deer from the Morey Bench Area (Figure 1). This area was selected because of its proximity to the test area and also because it is the winter habitat of large herds of deer.

These animals were shot and dissected according to an established protocol and subjected to post-mortem examinations. Tissue samples were collected for radioanalysis and histopathological examination as outlined in SWRHL ITR-11. Gamma spectroscopy and/or radiochemistry of the various biological samples included analysis for ^{131}I, ^{106}Ru, ^{144}Ce, ^{54}Mn, ^{140}Ba, ^{137}Cs, ^{65}Zn, ^{89}Sr, ^{90}Sr, ^{95}Zr, and total potassium.**

Tissues collected for radioanalysis were abomasal content, abomasal tissue, proximal 6" of the femur, liver, lung, muscle, rumen contents, thyroid, and hock joint.

Tissues collected for histopathology were heart, kidneys, liver, lung, muscle, spleen, thyroid, and any tissues which appeared grossly abnormal.

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*Cancer eye (squamous cell carcinoma) and physical deformities.

**Potassium-40 is found in physiologically normal tissues at a fixed percent (0.0118) with stable potassium (K). Within this report, potassium values are calculated from the measured radioactive potassium using the 0.0118 ratio and are recorded as total potassium.

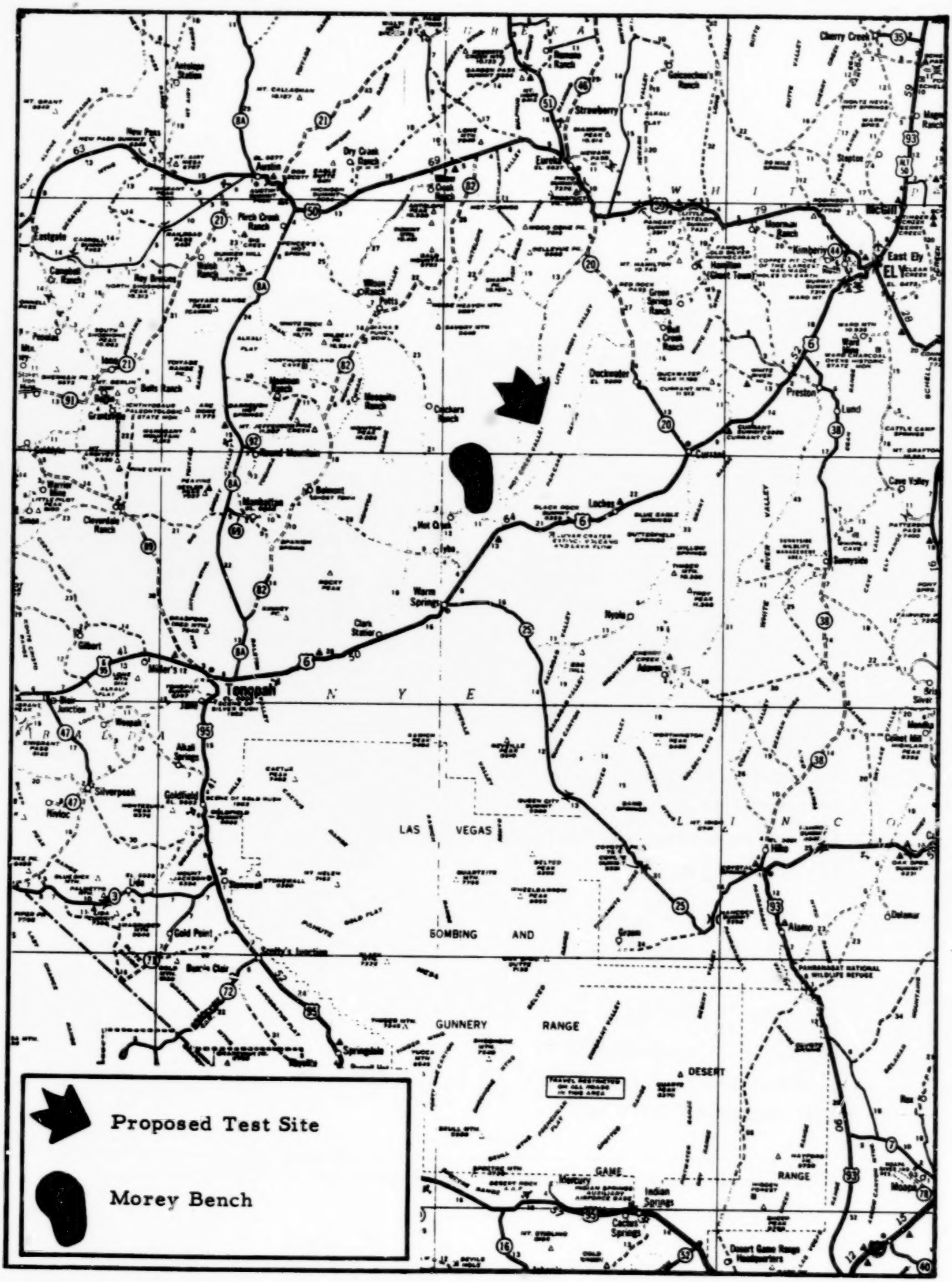

Figure 1. Proposed Supplemental Test Site and Morey Bench.

RADIOANALYSIS RESULTS AND DISCUSSION

Radioanalysis of the tissues from the mule deer and the cattle revealed very low or nondetectable levels of all radionuclides except for strontium-89 and -90 in the tarsal and femoral bones of the respective species and ^{131}I in the thyroids of the deer (Appendix A). The greatest variety of radionuclides occurred in the rumen and abomasum contents (Table A-3 and A-4). Rumen contents yielded ^{131}I in the deer, ^{144}Ce in two cows and the deer, ^{140}Ba in the deer, ^{106}Ru in one deer, ^{65}Zn in one cow, and ^{95}Zr in one deer. Abomasal content yielded ^{131}I in two cows, ^{144}Ce in a cow and a deer, ^{140}Ba in a cow, ^{106}Ru in two cows and a deer, ^{137}Cs in a cow, ^{65}Zn in a cow, and ^{95}Zr in two cows and a deer. The abomasal tissue contained ^{54}Mn and ^{65}Zn in one cow and ^{106}Ru in another cow (Table A-5). The liver contained ^{54}Mn and ^{95}Zr in one cow and ^{137}Cs in a deer (Table A-6). Muscle contained ^{144}Ce and ^{54}Mn in one cow each and ^{137}Cs, ^{65}Zn, and ^{95}Zr in a deer (Table A-2). There were no radionuclides present in any of the lungs analyzed (Table A-7). Femoral bone samples from the cows and tarsal bones from the deer--all revealed the presence of strontium-89 and -90 (Table A-8). With the exception of ^{131}I, radionuclides values were equal to or below those reported in tissues collected during routine slaughters of cattle from the Knoll Creek, Delamar Valley, and NTS areas and deer collected on the NTS. The source of the ^{131}I found in the deer thyroids is thought to have come from atmospheric fallout resulting from non-United States nuclear tests conducted on 24 December 1967.*

The levels of radioactive isotopes reported in these animals have little significance other than baselines for comparison with animals collected following events conducted on the Supplemental Test Site. Should there be a significant delay prior to further testing, additional animals should be collected to determine if any change has occurred in the levels of isotopes reported from this sampling especially in view of the higher than expected ^{131}I levels.

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*Southwestern Radiological Health Laboratory Air Surveillance Network, January 1968 Air Results.

PATHOLOGY RESULTS AND DISCUSSION

Pathologic lesions occurring in these animals were consistant with previously reported lesions found during other routine slaughters (BER-8 and BER-18). The observed lesions (see Appendix B) can be attributed to advanced age, natural disease processes, or traumatic injury.

Lesions in the deer were limited to sarcosporidiosis in skeletal and cardiac muscles and focal atelectasis in the lungs. The only gross lesion* observed at the time of necropsy was pleural adhesions to the right lobe of one lung.

Significant gross lesions in the cattle included ecchymotic hemorrhages in the lungs, fibrous adhesions between the liver and diaphragm, gall stones, subcutaneous botfly larvae, and a cystic kidney. Microscopic lesions included sarcosporidiosis in cardiac and skeletal muscles; pyelonephritis and several foci of lymphocytic infiltration suggestive of lymphosarcoma in one kidney; microcysts, fibrosis, and mineralization of collecting tubules in another kidney; foci of lymphocytic accumulations and focal atelectasis in the lungs; focal hypertrophy and hyperplasia of reticuloendothelial cells in the liver; and squamous cell carcinoma of the corneal epithelium.

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*With the exception of gunshot damage.

SUMMARY

Animals collected on the STS were subjected to thorough radioanalytic and histopathologic examinations. Results indicate that these animals are comparable to animals collected during other routine sacrifices--both in pathologic lesions present and detectable body burdens of selected radioisotopes--except for the increased level of ^{131}I in the thyroids of the deer and one of the cows. A tentative explanation of this exception could possible be a result of fallout from Non-United States nuclear tests. Presence of the other radioisotopes was erratic and only slightly above background levels. The pathologic lesions observed were attributable to degenerative and/or acquired conditions commonly seen with advanced age, traumatic injury, metabolic disturbances, or infection.

Since (as expected) there was no release of radioactivity from the Faultless event, no animals were collected following the event for post-mortem analysis.

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APPENDIX A

RADIOANALYSIS RESULTS--BOVINE AND MULE DEER

Table A-1. Thyroid.

AIP NO.	^{131}I pCi/g	^{144}Ce pCi/g	^{54}Mn pCi/g	^{140}Ba pCi/g	^{106}Ru pCi/g	^{137}Cs pCi/g	^{65}Zn pCi/g	^{95}Zr pCi/g	K g/g
BOV-1-N14-68	ND	ND	1.36	ND	ND	ND	ND	ND	ND
BOV-2-N14-68	8.45	ND	ND	ND	ND	ND	ND	ND	ND
BOV-3-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	ND
MD-1-N14-68	148	ND	ND	ND	ND	ND	ND	ND	ND
MD-2-N14-68	204	ND	ND	ND	ND	ND	ND	ND	ND

ND = Nondetectable

Table A-2. Muscle.

AIP NO.	^{131}I pCi/g	^{144}Ce pCi/g	^{54}Mn pCi/g	^{140}Ba pCi/g	^{106}Ru pCi/g	^{137}Cs pCi/g	^{65}Zn pCi/g	^{95}Zr pCi/g	K g/g
BOV-1-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	0.0048
BOV-2-N14-68	ND	ND	0.051	ND	ND	ND	ND	ND	0.0031
BOV-3-N14-68	ND	0.043	ND	ND	ND	ND	ND	ND	0.0035
MD-1-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	ND
MD-2-N14-68	ND	ND	ND	ND	ND	0.092	1.84	0.065	0.0032

ND = Nondetectable

Table A-3. Rumen Contents.

AIP NO.	^{131}I pCi/g	^{144}Ce pCi/g	^{54}Mn pCi/g	^{140}Ba pCi/g	^{106}Ru pCi/g	^{137}Cs pCi/g	^{65}Zn pCi/g	^{95}Zr pCi/g	K g/g
BOV-1-N14-68	ND	0.585	ND	ND	ND	ND	ND	ND	ND
BOV-2-N14-68	ND	0.065	ND	ND	ND	ND	2.59	ND	0.0010
BOV-3-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	ND
MD-1-N14-68	0.101	0.904	ND	0.071	ND	ND	ND	ND	0.0019
MB-2-N14-68	0.100	1.990	ND	0.111	0.246	ND	ND	1.12	ND

ND = Nondetectable

Table A-4. Abomasum Contents.

AIP NO.	^{131}I pCi/g	^{144}Ce pCi/g	^{54}Mn pCi/g	^{140}Ba pCi/g	^{106}Ru pCi/g	^{137}Cs pCi/g	^{65}Zn pCi/g	^{95}Zr pCi/g	K g/g
BOV-1-N15-68	0.071	ND	ND	ND	ND	ND	ND	0.149	0.0014
BOV-2-N14-68	0.209	1.35	ND	0.095	0.221	0.224	1.95	0.097	0.0135
BOV-3-N14-68	ND	ND	ND	ND	0.105	ND	ND	ND	ND
MD-1-N14-68	ND	2.25	ND	ND	0.484	ND	ND	1.89	0.0029
MD-2-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Nondetectable

Table A-5. Abomasum Tissue.

AIP NO.	^{131}I pCi/g	^{144}Ce pCi/g	^{54}Mn pCi/g	^{140}Ba pCi/g	^{106}Ru pCi/g	^{137}Cs pCi/g	^{65}Zn pCi/g	^{95}Zr pCi/g	K g/g
BOV-1-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	ND
BOV-2-N14-68	ND	ND	0.057	ND	ND	ND	0.081	ND	0.0015
BOV-3-N14-68	ND	ND	ND	ND	0.154	ND	ND	ND	ND
MD-1-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	ND
MD-2-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Nondetectable

Table A-6. Liver.

AIP NO.	^{131}I pCi/g	^{144}Ce pCi/g	^{54}Mn pCi/g	^{140}Ba pCi/g	^{106}Ru pCi/g	^{137}Cs pCi/g	^{65}Zn pCi/g	^{95}Zr pCi/g	K g/g
BOV-1-N14-68	ND	ND	0.048	ND	ND	ND	ND	0.049	0.0026
BOV-2-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	0.0023
BOV-3-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	0.0023
MD-1-N14-68	ND	ND	ND	ND	ND	0.058	ND	ND	0.0029
MD-2-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Nondetectable

Table A-7. Lung.

AIP NO.	^{131}I pCi/g	^{144}Ce pCi/g	^{54}Mn pCi/g	^{140}Ba pCi/g	^{106}Ru pCi/g	^{137}Cs pCi/g	^{65}Zn pCi/g	^{95}Zr pCi/g	K g/g
BOV-1-N14-68	NA	NA	NA	NA	NA	NA	NA	NA	NA
BOV-2-N14-68	NA	NA	NA	NA	NA	NA	NA	NA	NA
BOV-3-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	0.0024
MD-1-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	ND
MD-2-N14-68	ND	ND	ND	ND	ND	ND	ND	ND	ND

NA = Not Analyzed
ND = Nondetectable

Table A-8. Bone.

AIP NO.	^{89}Sr pCi/g Bone Ash	^{90}Sr pCi/g Bone Ash
BOV-1-N14-68	3.672 ± 0.853*	5.809 ± 0.461*
BOV-2-N14-68	2.173 ± 1.275	14.532 ± 0.715
BOV-3-N14-68	3.783 ± 1.197	15.473 ± 0.710
MD-1-N14-68	2.461 ± 1.064	9.877 ± 0.625
MD-2-N14-68	2.899 ± 1.648	23.217 ± 0.993

* Counting error

APPENDIX B

NECROPSY PROTOCOLS

1. AIP No. BOV-1-N14-68

a. History. This animal was born and spent its entire life on the Site "C" Supplemental Test Site open range area.

DATE OF DEATH: 10 Jan. 1968 HOUR: 0900 LOCATION: Well 3, NTS

DATE OF NECROPSY: 10 Jan. 1968 HOUR: 0930 LOCATION: Well 3, NTS

SEX: Male AGE: 1 year

SPECIES: Bovine BREED: Hereford

b. External Appearance. This is a long yearling Hereford steer in poor physical condition. Both hind feet are deformed at their distal ends. The horny covering of the third and fourth digits of the left hind foot are missing and have been replaced by a fibrous pad. The horny coverings of the third and fourth digits of the right hind foot have a convex shape. Due to this abnormal shape, the animal walked on the volar surface of the sole near the area of the digital cushion resulting in a heavy fibrous covering in this area.

c. Respiratory System. Diffuse ecchymotic hemorrhages are seen in the right and left apical and cardiac lobes.

d. Miscellaneous. Hypoderma bovis larvae are found in the sub-dermal tissue of the back.

e. Necropsy Results.

(1) Liver: There is hypertrophy and focal hyperplasia of the reticuloendothelial cells.

(2) Kidney: Focal accumulation of lymphocytes interstitially which is suggestive of early lymphosarcoma.

2. AIP No. BOV-2-N14-68

a. History. This animal was born and spent its entire life on the Site "C" Supplemental Test Site open range area.

DATE OF DEATH: 10 Jan. 1968 HOUR: 0900 LOCATION: Well 3, NTS

DATE OF NECROPSY: 10 Jan. 1968 HOUR: 1015 LOCATION: Well 3, NTS

SEX: Female AGE: 13 years

SPECIES: Bovine BREED: Hereford

b. External Appearance. This is a mature, nonlactating Hereford cow in poor physical condition. Carcinomas are seen on the cornea of both eyes.

c. Digestive System. There are extensive fibrous adhesions between the peritoneal surface of the liver and the serosa of the diaphragm. Approximately 10 small stones, 5 mm in diameter, are seen in the gall bladder.

d. Genitourinary System. The uterus contains a fetus which is in approximately the third month of gestation.

e. Necropsy Results.

(1) Cardiac Muscle: Moderate sarcosporidiosis is present.

(2) Kidney: Multiple foci of accumulated immature and mature lymphocytes suggestive of lymphosarcoma. There are focal areas of proximal pyelonephritis characterized by the presence of polymorphonuclear leukocytes in the tubules.

(3) Striated Muscle: There is slight sarcosporidiosis.

(4) Liver: There is focal hypertrophy and hyperplasia of reticuloendothelial cells.

(5) Eye: Squamous cell carcinoma which originates from the corneal epithelium.

3. AIP No. BOV-3-N14-68

a. History. This animal was born and spent its entire life on the Site "C" Supplemental Test Site open range area.

DATE OF DEATH: 10 Jan. 1968	HOUR: 0900	LOCATION: Well 3, NTS
DATE OF NECROPSY: 10 Jan. 1968	HOUR: 1100	LOCATION: Well 3, NTS
SEX: Female	AGE: 14 years	
SPECIES: Bovine	BREED: Hereford	

b. External Appearance. This is a mature Hereford cow in poor physical condition.

c. Digestive System. Extensive fibrous adhesions are seen between the peritoneal surface of the diaphragm and the serosa of the liver.

d. Genitourinary System. The kidney contains two small fluid-filled cysts approximately 3 mm in diameter. Tissues of these areas are submitted for histopathologic study.

e. Necropsy Results.

(1) Striated Muscle: There is moderate sarcosporidiosis.

(2) Cardiac Muscle: There is moderate sarcosporidiosis.

(3) Kidney: There are several foci of fibrosis or chronic nephritis. In addition, there are microcysts characterized by the absence of kidney parenchyma and the crowding to together of peripheral structures. There is also mineralization of many collecting tubules.

(4) Lung: There are foci of lymphocytic accumulations subpleurally and within septa.

4. AIP No. MD-1-N14-68

a. History. This animal was collected in the Morey Bench area.

DATE OF DEATH: 16 Jan. 1968 HOUR: 2130

LOCATION: 4-Mile Canyon (STS)

DATE OF NECROPSY: 16 Jan. 1968 HOUR: 2130

LOCATION: 4-Mile Canyon (STS)

SEX: Female AGE: 4 years WEIGHT: 125 lb. METHOD: Estimation

SPECIES: Odocoileus heminus COMMON NAME: Mule Deer

b. External Appearance. This is a female deer in good condition. The left humerus is fractured (due to bullet).

c. Genitourinary System. The uterus contains two fetuses estimated to be in the first trimester of gestation.

d. Respiratory System. There are diffuse ecchymotic hemorrhages throughout all lobes of the lung. The left apical lobe is macerated by a bullet.

e. Necropsy Results.

(1) Lung: Extensive alveolar hemorrhage and free blood within the bronchioles.

(2) Skeletal Muscle: Slight sarcosporidiosis.

5. AIP No. MD-2-N14-68

a. History. This animal was collected in the Morey Bench area.

DATE OF DEATH: 17 Jan. 1968 HOUR: 2000

LOCATION: 4-Mile Canyon (STS)

DATE OF NECROPSY: 17 Jan. 1968 HOUR: 2000

LOCATION: 4-Mile Canyon (STS)

SEX: Female AGE: 2 1/2 years WEIGHT: 100 lb.

METHOD: Estimation

SPECIES: Odocoileus hemionus COMMON NAME: Mule Deer

b. External Appearance. This is a female deer in good condition.

c. Genitourinary System. The uterus contains a fetus estimated to be in the first trimester of gestation.

d. Respiratory System. All lobes of the lung contain diffuse ecchymotic hemorrhages. The left apical lobe is completely macerated by the bullet. The right lobes of the lung have fibrous adhesions extending from their peripheral border to the chest wall.

e. Necropsy Results.

(1) Lung: There are focal areas of atelectasis.

(2) Cardiac Muscle: There is slight sarcosporidiosis.